Caltrans

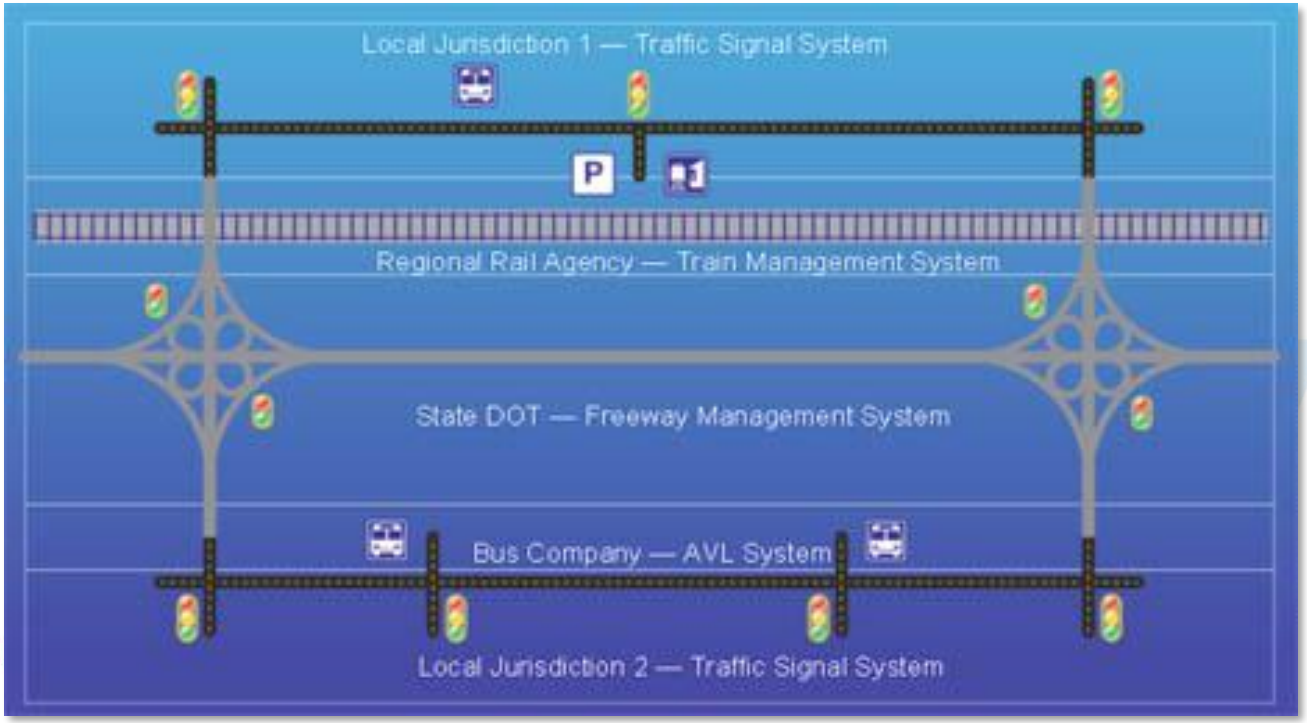
CALTRANS REGIONAL OPERATIONS FORUMS

Advanced Corridor Operations Techniques

What Is a Corridor?

"A broad geographical band that follows a general directional flow connecting major sources of trips that may contain a number of streets, highways and transit route alignments."

From "Glossary of Regional Transportation Systems Management and Operations Terms" (TRB Circular)



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How Travelers Use a Corridor

- Travelers view the transportation network as a whole
- When faced with congestion on one facility, travelers may respond by
  - Selecting a different facility (transit or roadway),
  - Adjusting their trip to another time of day, or
  - Remaining on their current route
- Should we manage the corridor to reflect how travelers use it?

Corridor Management

- Corridors offer opportunities to operate and optimize the entire system
  - Beyond individual networks
- Transportation corridors often contain unused capacity
  - Parallel routes
  - Non-peak direction
  - Single-occupant vehicles
  - Underutilized transit services
- Managing the corridor can more fully utilize this capacity
  - Management approaches like ramp metering
  - Traveler information and outreach

Active Traffic Management

What Is Active Traffic Management?

Traffic management concepts intended to:

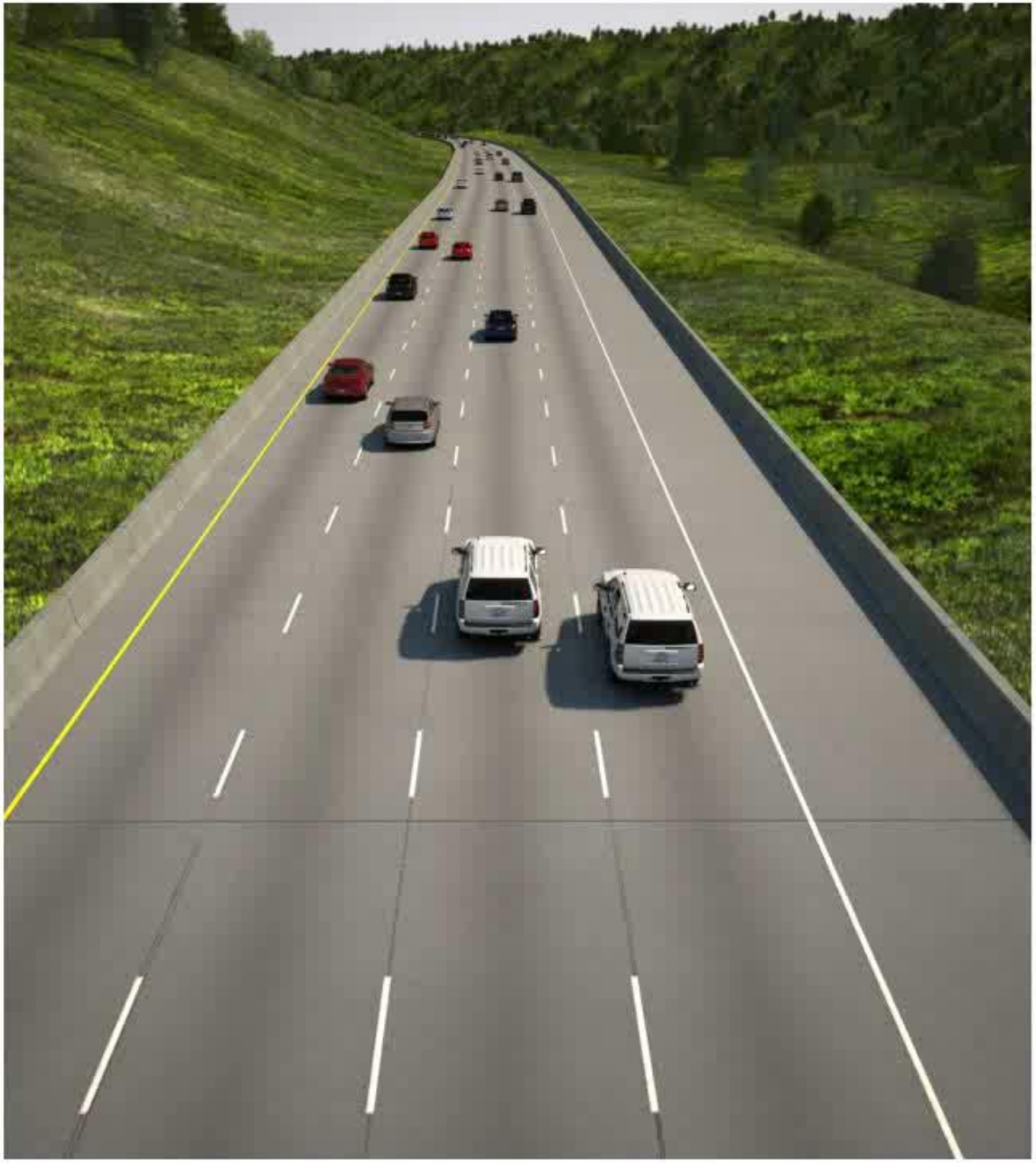
- Enhance roadway safety
- Reduce congestion
- Provide reliable trips
- Provide enhanced information to motorists
- Leverage available capacity during periods of congestion or incidents

M 42 Speed Harmonization and hard shoulder lane in England. (UK Highways Agency)

Examples of ATM

- Lane-use control
- Variable speed limits / advisories
- Queue warning
- Hard shoulder running
- Dynamic re-routing
- Junction control
- Adaptive ramp metering

Active Traffic Management is not limited to urban areas!



Active Traffic Management Simulation

Scenario 3: Two-Lane Incident Closure with Congestion

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Active Traffic Management Simulation

Scenario 5A: Add Lane To Drop Lane - Closed

Scenario 6A: Add Lane and Drop Lane - Open

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Examples of ATM in the US

- Seattle
- Minneapolis
- I-66 (Northern Virginia)
- Los Angeles
- Dallas “Horseshoe”
- Denver
- Utah I-80 Parley’s Canyon
- I-80 (SF Bay Area)
- New York Long Island Expressway
- Philadelphia I-95
- Portland, OR
- New Jersey
- I-80 Wyoming
- Others?

Many examples in Europe and around the world!

Variable Speed System on Rural Corridors

I-80 in Wyoming

I-80 in Utah, Parley's Canyon

Wyoming I-80

- AADT 11,000
- <50% of I-80 traffic is heavy trucks

Significantly reduced crashes for trucks and other vehicles

I-80 Integrated Corridor Mobility

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Freeway Infrastructure

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I-80 Corridor

- Institutional Environment
  - 1 DOT, 9 cities, 2 MPOs, 2 transit agencies
  - Different stages of infrastructure
- Staging of implementation
  - Arterials first, freeways next (some delays due to concrete piles)
  - Some equipment went out of warranty before complete
- Maintenance
  - MOU for local agencies
  - Regional maintenance agreement for maintenance funding

OR217 Portland, OR

- Launched July 2014
- 7.5 miles, 110,000 AADT
- Incorporated travel times
- Variable speeds
- Enhanced existing adaptive ramp metering system

- Metering rates adjustable through corridor

WSDOT's Smarter Highways

- Variable speed limits, lane control, traveler information
- Reduce speeds approaching congestion, crashes, work zones
- Warn motorists of downstream queues
- Display which lanes are open, closed, and closed ahead
- Primary objective is safety improvement

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ATM in Action in Seattle Area

Los Angeles Junction Control

- NB SR 101 to NB I-5 connector
- High collision experience
- Congestion
- High ramp demand

Re-stripe Connector to Two Lanes

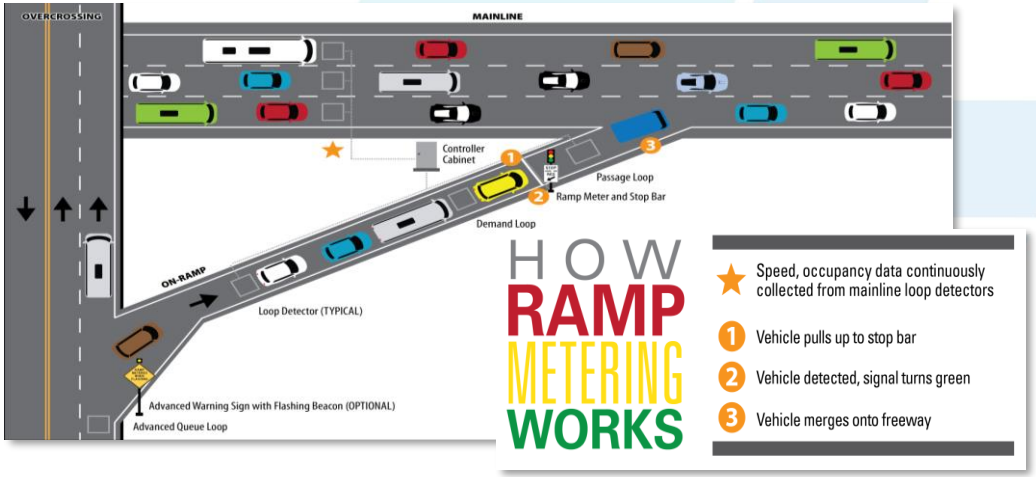
Replace Crash Attenuators

The Use of ATM is Expanding

- ATM has moved beyond stand alone implementations
- ATM is compatible with other combined, integrated approaches
  - Traffic incident management
  - Work zone traffic management
  - Managed lanes

Ramp Metering

- Reduces overall freeway congestion by managing the amount of traffic entering the freeway and by breaking up platoons
- Algorithm determines entrance rate based on mainline volume, speed, queue length
  - ↳ Objective is to limit the amount of traffic entering freeway to minimize flow breakdown
- Widely used throughout California
- What about the Altamont Corridor?



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Ramp Metering Benefits

- Mobility, Reliability, and Efficiency
  - Reduced travel times
  - Increased travel time reliability
  - Increased mainline speeds
- Safety
  - Crash reduction
- Reduced Environmental Impacts
  - Reduces stop-and-go conditions
  - Less fuel consumed
- Low cost with High Benefit/Cost Ratio
  - Cost effectiveness
  - Twin Cities metering had B/C ratio of 15 : 1
- <u>Probably the most proven freeway management strategy</u>
  - Leverage ITS infrastructure
  - Reduced environmental documentation

Ramp Meter Safety Benefits

Location	Benefit
Portland, OR	43% reduction in peak period collisions
Minneapolis, MN	24% reduction in peak period collisions
Seattle, WA	39% reduction in collision rate
Denver, CO	50% reduction in rear-end collisions
Detroit, MI	50% reduction in total collisions and 71% reduction in injury collisions
Long Island, NY	15% reduction in collision rate

FHWA Ramp Management Handbook

Public Perception Challenges

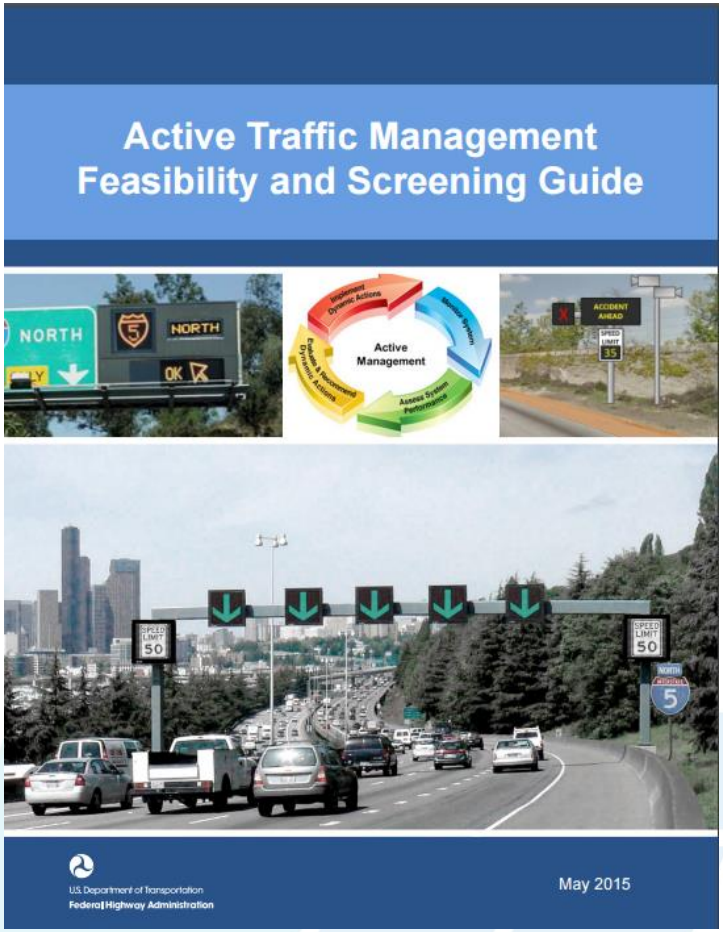
- Understanding of Purpose and Benefits
- Metering during congested vs non-congested time-of-day
- Comparisons to adjacent ramp conditions
  - Wait Time
  - Cycle Length
- Metering congested vs non-congested roadways

Is ATM the Right Solution?

- ATM sounds great! How do I get started?
- Important considerations:
  - What roadway networks and facilities would be best suited for ATM in my region?
  - What specific or combination of ATM strategies would work best?
  - What would be the range of expected benefits?
  - What would be the expected costs (capital and ongoing)?

Guidance Document

ATM Feasibility and Screening Guide



http://www.ops.fhwa.dot.gov/publications/fhwahop14019/fhwahop14019.pdf

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Success Factors

- High traffic volumes
- Changes in prevailing conditions
- High prevalence of crashes
- Bottlenecks
- Adverse weather
- Variability in trip reliability
- Construction impacts
- Financial constraints
- Limitation in capacity expansion

Examples of ATM Benefits in US

I-5 Seattle

- 4.1% reduction in crashes
- 4.4 % increase in crashes on SB segment of I-5 (no ATM)

Minneapolis

- 20+ % decrease in PDO crashes
- 17% less congestion during AM peak

OR217 Portland

- 21% reduction in crashes
- 5% increase in throughput during peak period
- 10% reduction travel time variability

LA Junction Control

- NB SR-110 to NB I-5
- Average ramp delay decreased from 20 minutes to 5 minutes
- 30% decrease in crashes

Chicago Bus on Shoulder

- On-time performance from 68% to 92%
- No adverse impact on safety

Cost Considerations

- Gantries and signs
  - Need to make assumptions on spacing and layout
- Widening, refuge areas, shoulder treatments
  - Environmental issues
- Ramp treatments
- Traffic signal controllers
- Detection
- Communications / power
- New software
  - Automated algorithms / decision support
- Systems engineering activities
- Public outreach
- On-going operations and maintenance
  - Training
- Contingency

Assumptions on Gantry Spacing and Layout

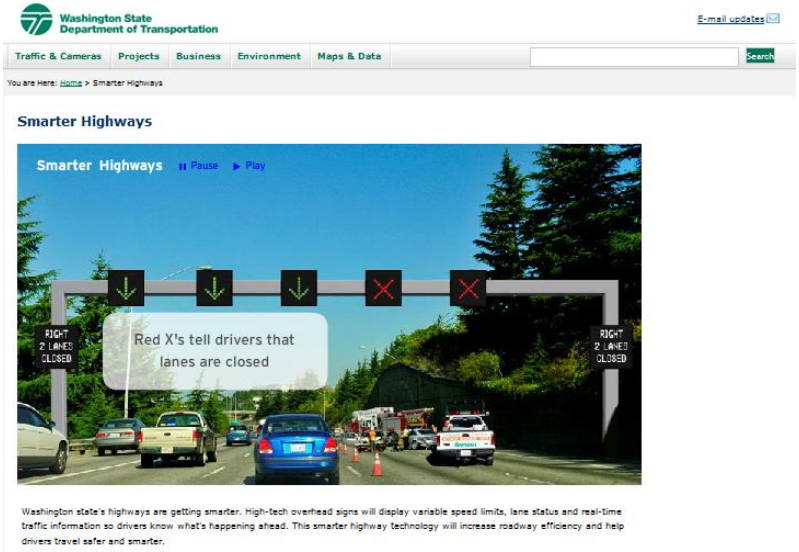
- Concerns with costs of frequent full gantries
- MUTCD requirements on guide sign distances
  - 600 to 800 feet
- Significant testing in UK of different spacing / layouts
  - Driver simulations
  - Visualization / response monitoring software

Moving towards more of a **HYBRID** approach ("ATM Lite")

- Longer spacings between full gantries (e.g., after on ramps)
- Use of side-mounted signs in-between
- Significant reduction in costs

WSDOT Outreach Examples

- Smarter highways video on Youtube http://www.youtube.com/wsdot#p/u/12/cd0doR0Ga-I
- Smarter highways www.smarterhighways.com
- Posted links on Twitter, Facebook and WSDOT blog
- Outreach to cities, counties, businesses, colleges



Group Discussion

- What other examples of ATM have you heard about?
- What technologies are in use here that you would consider active traffic management?
- What types of ATM could have a positive impact on operations in the Altamont corridor?

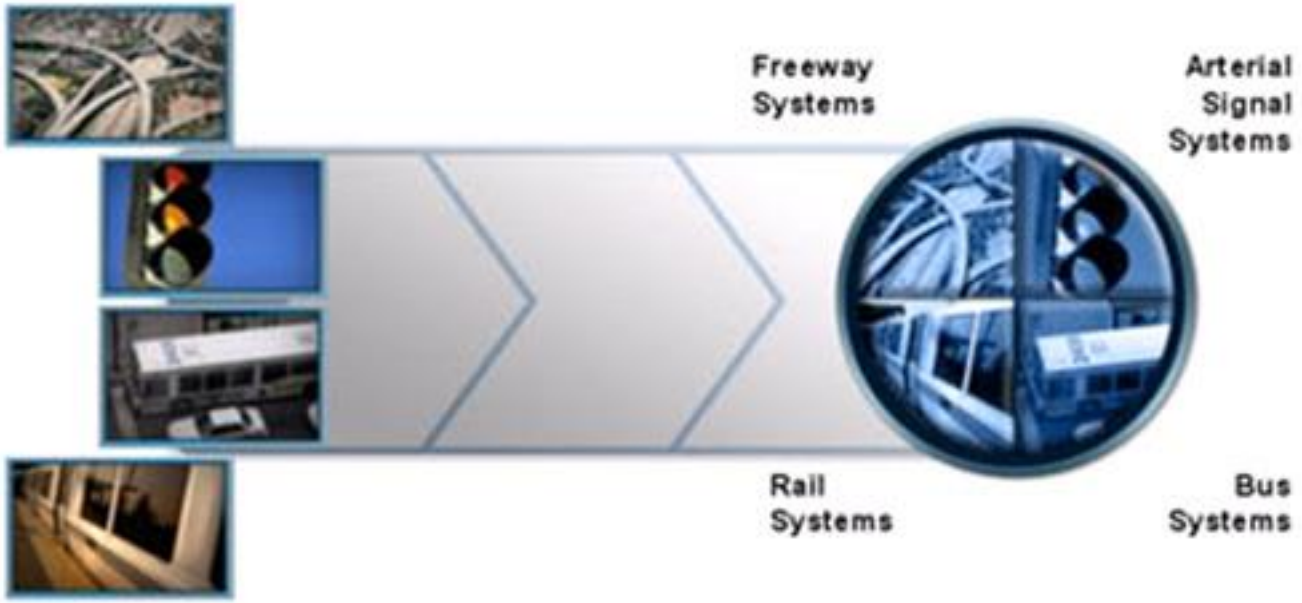
BREAK

INTEGRATED CORRIDOR MANAGEMENT

Integrated Corridor Management

- ICM Background and Concepts
- Status of the Federal ICM Initiative and Sites
- Planning for ICM
  - Stakeholders
  - Integrating with existing plans and programs
  - ICM Concept of Operations
  - Agreements
  - Modeling and Performance Measures
- Integration to Support ICM Strategies

What Is ICM?



- **Maximize corridor capacity through:**
  - New institutional models
  - New technology
  - More dynamic operational strategies

USDOT ICM Initiative

ICM Pilot Sites:

- San Diego, CA
- Dallas, TX

Key Elements:

- Decision Support Systems
- Institutional Agreements
- Operational Strategies
- Multimodal

ICM Planning Grants:

- I-10, Phoenix, AZ
- I-210, LA/Pasadena, CA
- SR4, Bay Area, CA
- I-95, Broward Co., FL
- I-95/MD295/US1, Baltimore, MD
- NJ Turnpike and US1
- NYC – multiple corridors
- I-90 Buffalo-Niagra, NY
- I-84, Portland, OR
- IH-10/US-54/IH-110, El Paso, TX
- IH-35, Austin, TX
- I-15, Salt Lake City, UT
- Northern VA – multiple corridors

SANDAG I-15 ICM

- Primary artery for the movement of commuters, goods, and services from north San Diego County to downtown.
- I-15 Managed Lanes System
- Multi Institutional Cooperation/ Partnerships
- Multi-modal Transportation Improvement Strategies and Mode Shift – BRT, TSP
- 511, including transit information

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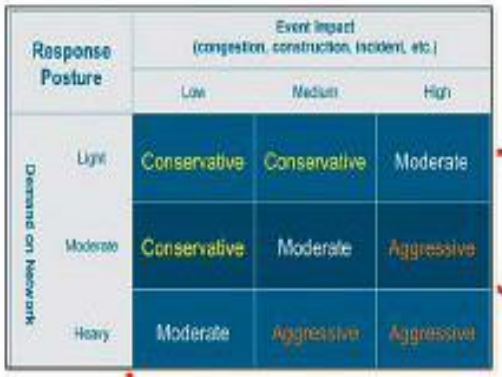
I-15 ICM Decision Support "Response Postures"



Demand

Light
- Weekends
- Holidays

Moderate
- Off-peak weekday
- Minor weekend special event

Heavy
- Peak-hour weekday traffic

Response Posture

Conservative
- Example – Provide slight increase to ramp metering rate

Moderate
- Example – Provide additional green-time to favor northbound traffic while still providing adequate cross-street timing

Aggressive
- Example – Display alternate route for freeway traffic on CSM, such as "INCIDENT AHEAD NB USE POMERADO"

Event Impact

Low
- Incident closing freeway shoulder or one lane
- Construction closing one lane of primary arterial
- Breakdown of transit vehicle

Medium
- Incident closing 1 freeway lane
- Closure of Express Lanes
- Construction on Pomerado reducing NB and SB to one lane each direction

High
- Major incident at intersection of primary arterials
- Closure of two or more lanes of the freeway
- Combination of low and medium incidents

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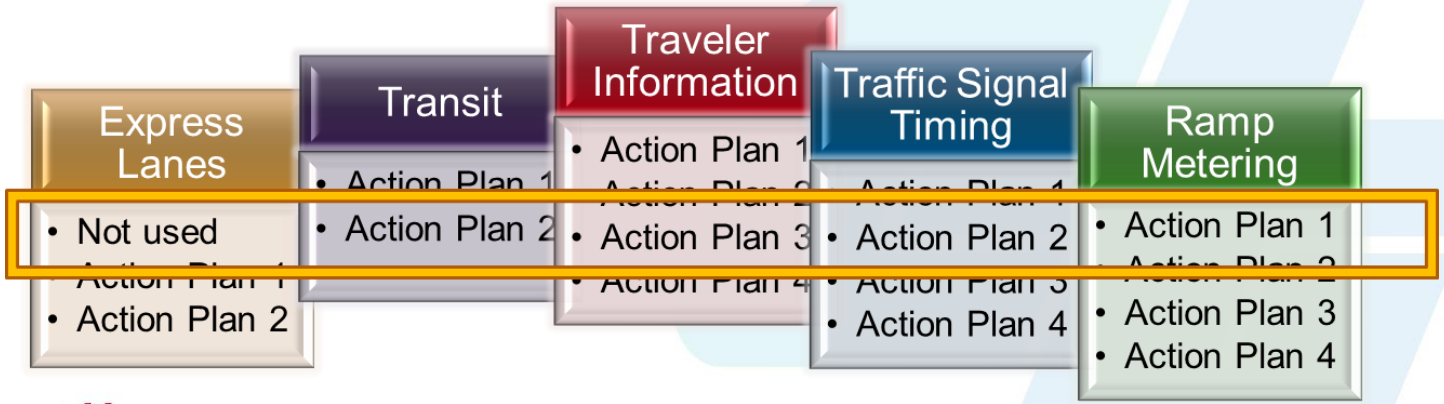
I-15 ICM Response Plans

- 156 Alternate Routes
- 260 Local Arterial Intersections
- 18 Metered Interchanges
- 20 Dynamic Message Signs
- 5 BRT stations
- 20 miles HOT – reversible lanes
- 30 miles Traffic Responsive
- 511 (including app)

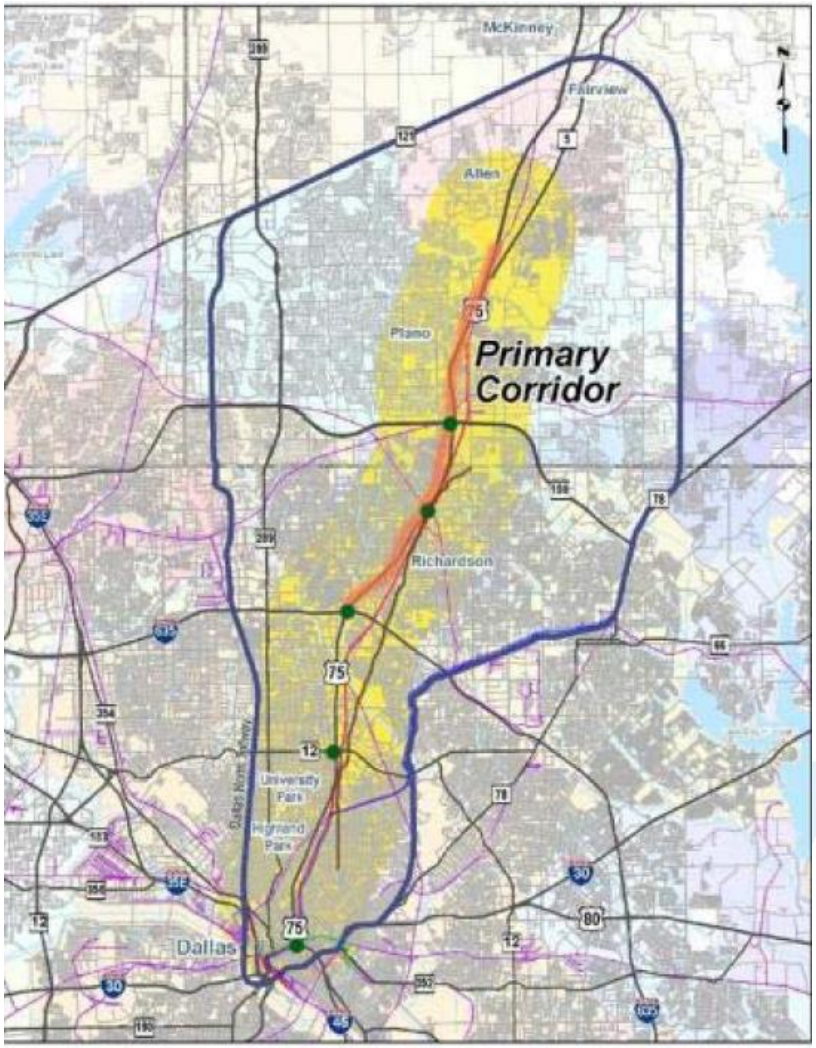
Limited set of "point-in-time" Response Plans by:

- Using Asset Restrictions
- Using Availability Conditions
- Using Thresholds to select "next move" relationships
- **= 1.5 billion combinations!**



Dallas US-75 ICM

- Freeway with continuous frontage roads
- Managed HOV lanes
- Dallas North Tollway
- Arterials
- Bus Network, Light Rail
- Approx. 900 traffic signals
- Multiple TMCs
- Regional ATIS (511)



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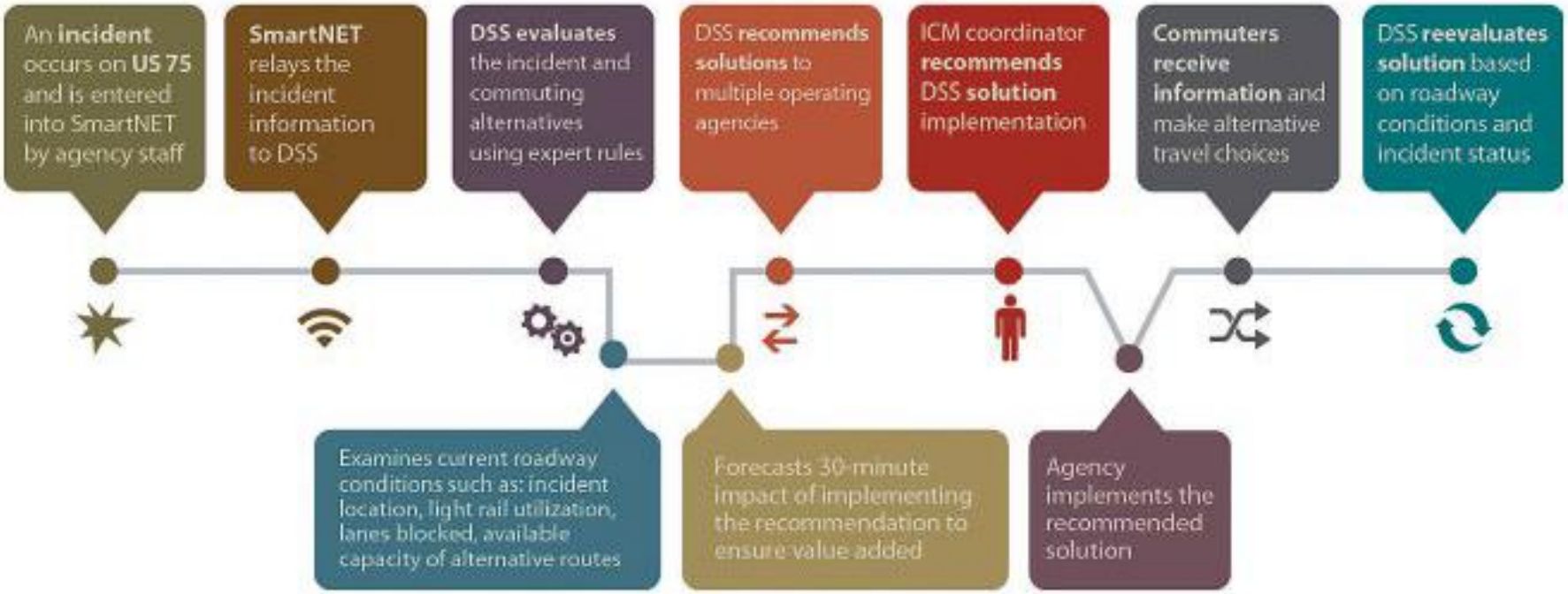
US 75 ICM Decision Support



THE BENEFITS

- **Improved travel time reliability for commuters**
- **Enhanced decision making support for operating agencies**
- **Achieves a 20:1 return ($278.8 million) on the project's cost over 10 years**
- **Less pollution from idling vehicles in congested traffic**

USDOT ICM Status Update

- San Diego and Dallas went “live” in early 2013
- Testing and evaluating the DSS in both regions (3-year evaluation)
- Independent evaluation
- Early lessons:
  - Agreements are tough. Most challenging part of ICM.
  - Data integration from multiple systems and multiple networks
  - Determining mode shift is difficult, working through how to evaluate effectiveness
  - Combinations of strategies also are challenging to evaluate

AZ Loop 101 ICM

- Arizona DOT, Scottsdale, Maricopa County, SRPMIC Tribe
- Event-driven ICM for freeway closures
- Positives:
  - Dense arterial ITS Experienced TMC staff
  - Provide arterial alt route
  - REACT to support arterial traffic diversions
- Focus on process improvements
- No new infrastructure

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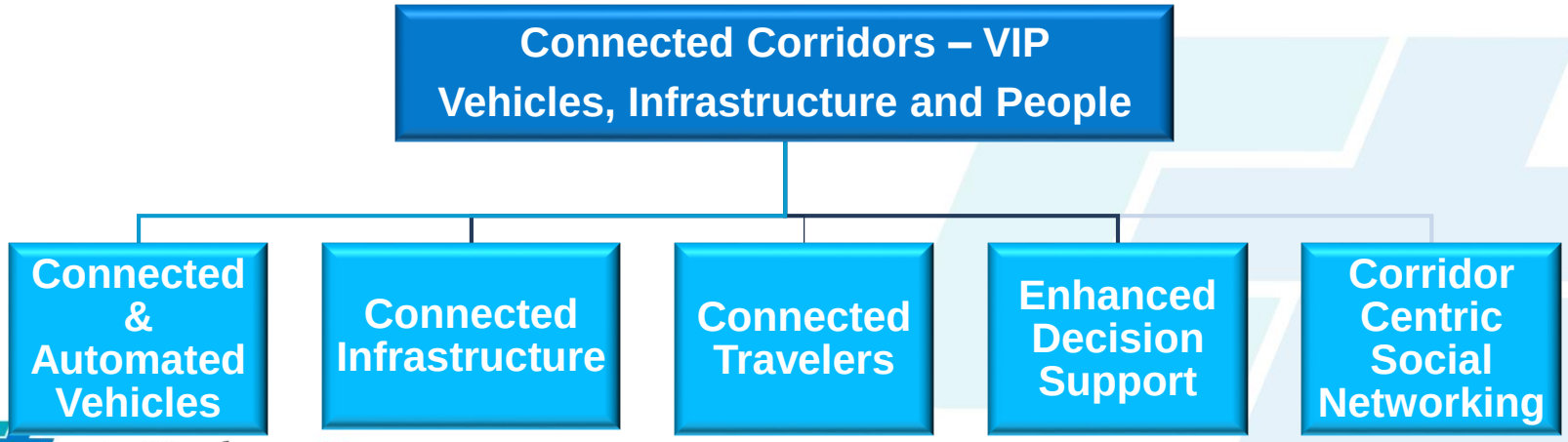
California Connected Corridors

- Initiated in 2011 – Statewide Framework
- Focus on planning, implementation, O&M
  - Implement TSM&O on their most congested corridors (50)
  - Evolve Caltrans to real-time operations and management
  - Enhance partnerships
  - Optimize infrastructure and capacity
  - Improve overall corridor performance



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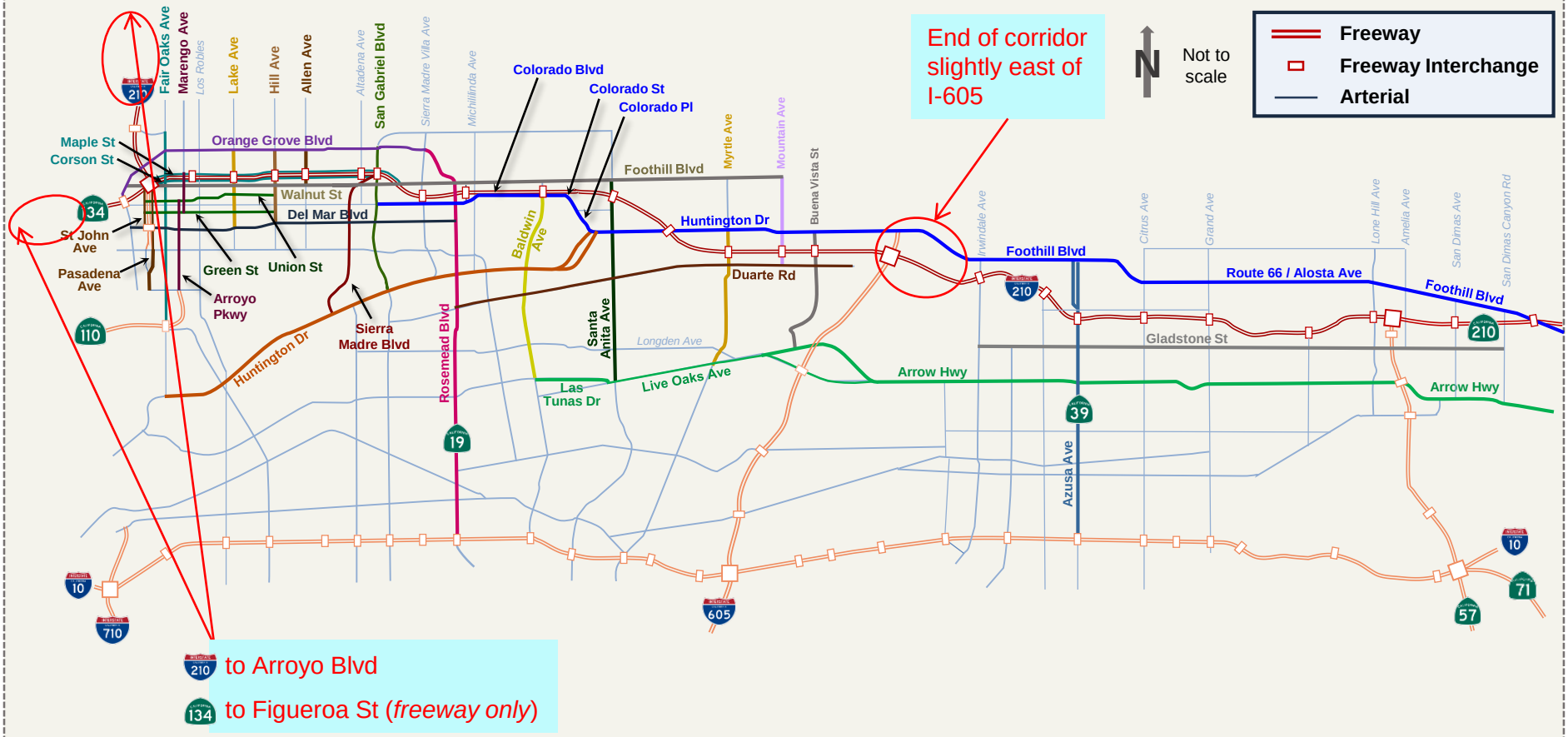
I-210 Project Corridor (Pilot)

Segment 1 Area of Interest

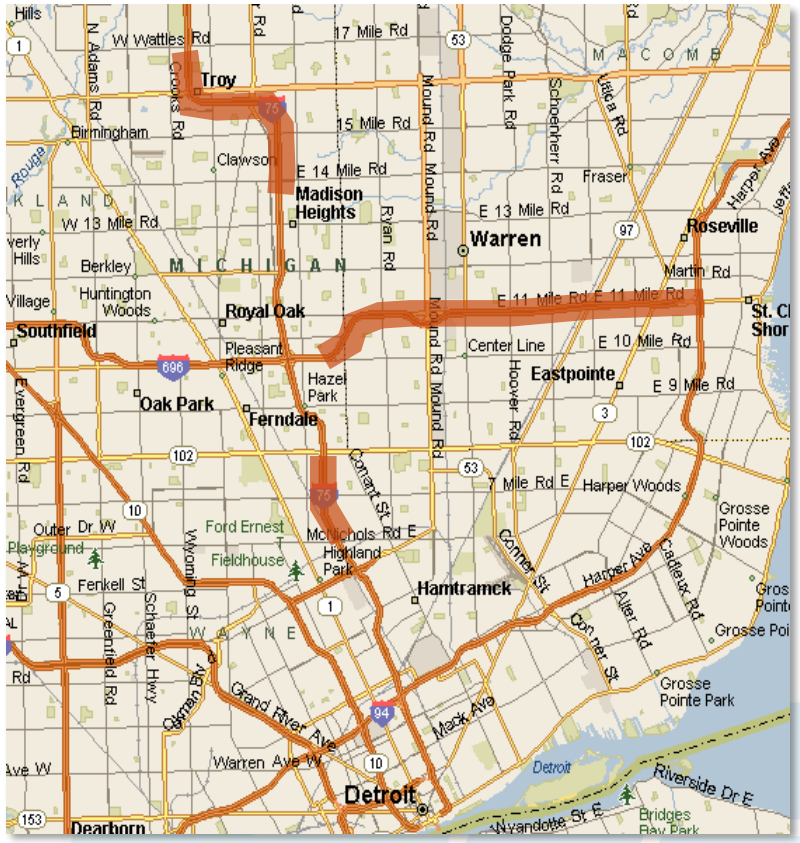


Michigan DOT I-75 Concept of Operations

- Travel time reliability within the corridor (freeways and arterials)
- Improved traveler information
- Incident response
- Improved agency coordination
- Coordinated use of resources and technologies
- Public outreach and education on multi-modal transportation options
- CVO through the corridor
- Developed a ConOps and Requirements (2008)
- Corridor Integration CMM helped guide areas for improvement

MDOT ICM Pilot Corridors

- 2 Pilots on I-75 (Wayne and Oakland Counties); I-696 in Macomb
- Event-based
  - Improve response to major incidents
  - Traffic rerouting on arterials
- ITS equipment upgrades and infill
- Signal timing on alt routes
  - Models show freeway recovery times increasing by 15-30 minutes



Stakeholder Roles for ICM

- Identifying the right partners
- Key partners
  - Freeway management and operations – TOC, freeway service patrol, freeway incident response
  - Arterial management and operations – TOC, signal operations
  - Transit
  - Incident response and management – freeway and arterial incident response/law enforcement
  - MPO – planning
  - Others to be determined on a regional level based on operational need
- ***Leadership commitment – key to sustaining partnerships. You already have this!***

Leveraging ICM

- ITS Plans or Updates/TSMO Planning
- Traffic Incident Management Coalitions
- Standing Committee Meetings (ITS Partners)
- Large-scale freeway or arterial improvement projects
- TIP funding cycles
- RTP updates
- Follow up initiatives from RCTO and other Ops Plans

Plant seeds, build interest, introduce ICM as a collaborative, regional effort

Analysis, Modeling and Simulation

- Test different scenarios identified in the ConOps
- Used available data and future projections
- Modeled ICM strategies under typical and incident conditions
- Results from the AMS showed:
  - Improved mobility, particularly during NRC
  - Improved reliability – 2% - 23%
  - Reduced toxic emissions and fuel consumption
  - Strong potential for fiscal benefits

ICM Performance Measures

- National evaluation is looking at the following MOEs:
  - Vehicle and person throughput
  - Travel times and travel time index
  - Standard deviation of travel time
  - 80th, 90th, and 95th percentile travel times
  - Buffer and Planning Indices
  - Traveler Response
  - Safety benefits
- Other ICM Objectives could be…
  - Traveler information
  - TIM
  - Data sharing
  - Institutional participation

Demonstration Site Measures

San Diego

- Travel Time
- Delay
- Throughput
- Reliability and Variance of Travel Time
- Safety
- Emissions and Fuel Consumption

Dallas

- Travel Time Reliability
- Increase Corridor Throughput
- Improve Incident Management
- Enable Intermodal Travel Decisions

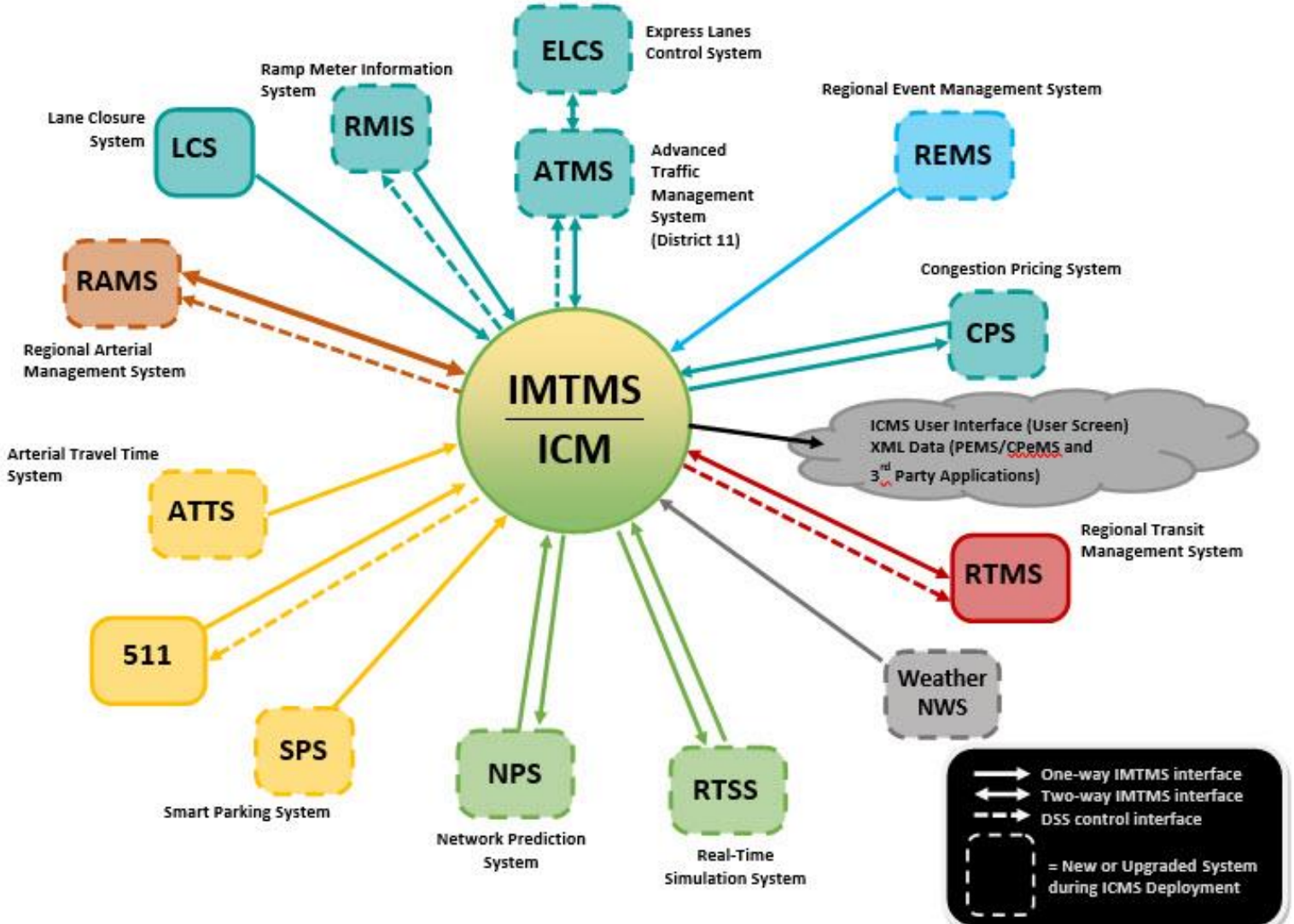
Interagency Agreements

- Essential for ICM and multi-agency operations strategies
- New operations models, potential for joint operations
- Data sharing and system connectivity
- Often, the most complex part of an ICM program and strategy
- Examples – I-80, SANDAG, AZ
  - Operating and operating authority
  - Data sharing parameters
  - Cost sharing
  - Decision making

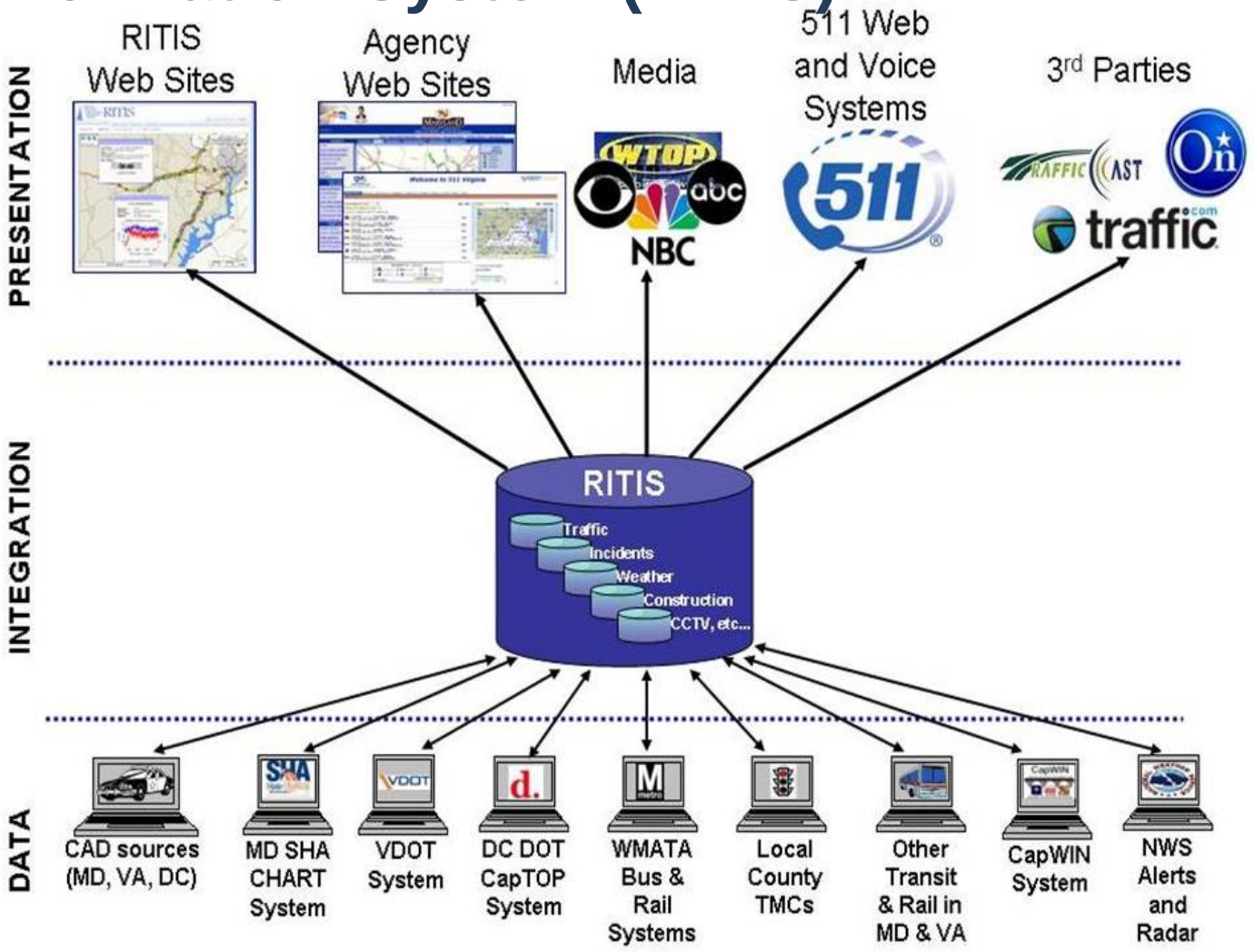
Real-time Data Sharing to Support ICM

- Regional strategies for sharing data
- What information do partners need?
- Operations data to support ICM
  - Real-time freeway, arterial and transit operations
  - Real-time strategy implementation information
  - Agency notifications
- Overcoming institutional barriers to effective data sharing
  - SANDAG (San Diego/D11)
  - RITIS (I-95)
  - RADS (Arizona)

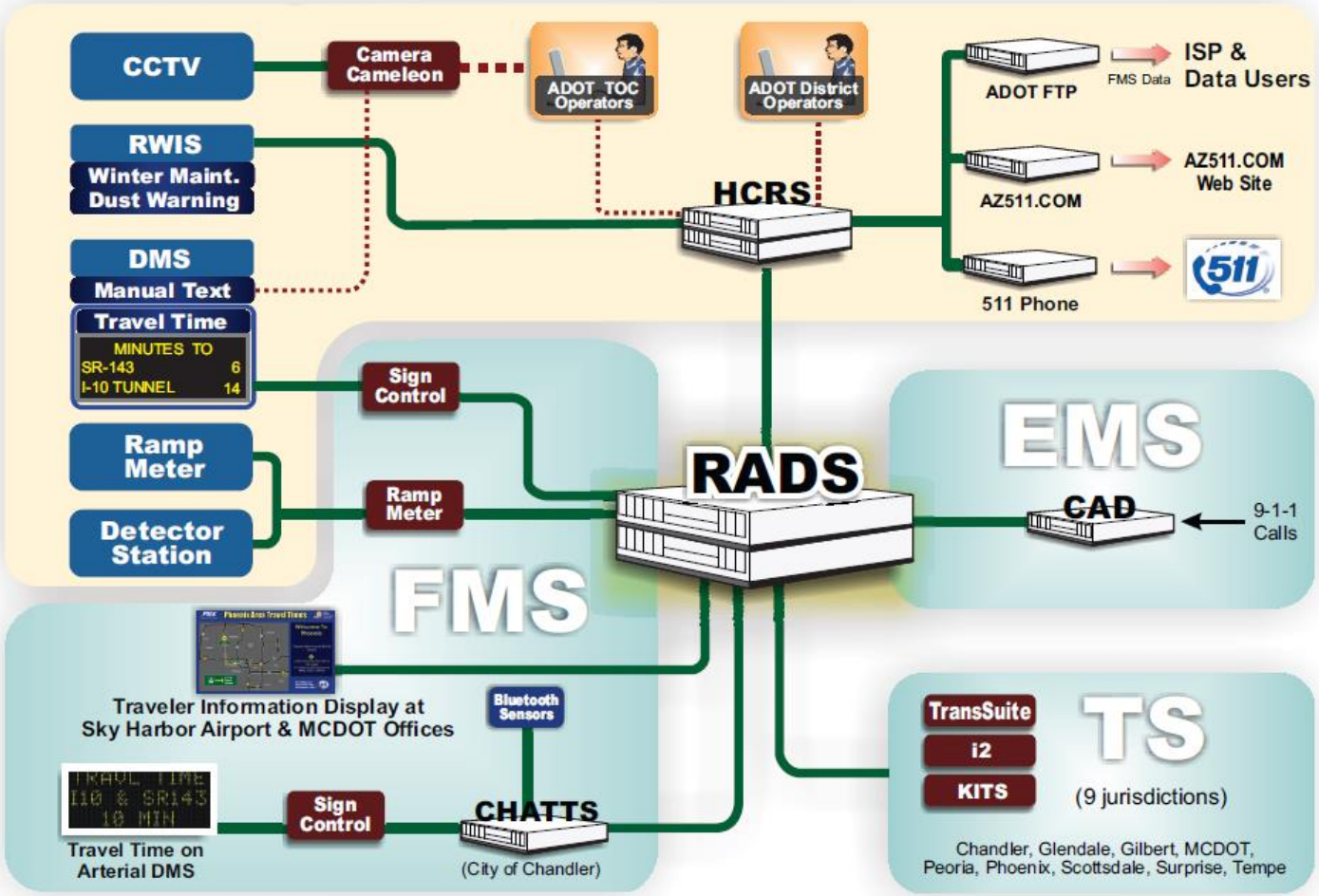
SANDAG Data Hub



Regional Integrated Transportation Information System (RITIS)



Regional Archived Data System



Staffing and Training

- Staff capacity building
  - Current staff vs. supplementing staff
  - Leveraging available regional technical staff resources
- Staff training needs for ICM and next-generation operations
  - New systems and new operational approaches
  - Multi-agency training strategies essential

ICM Resources

- California Connected Corridors
  - http://connected-corridors.berkeley.edu/
- FHWA/USDOT
  - its.dot.gov/icms
  - ICM Knowledge and Technology Transfer (KTT)
  - Guidance documents for each stage – planning, stakeholder engagement, design, test plan, modeling, training, lessons learned
  - Fact sheets

Managing a Corridor Considerations

- What is the status of the current ICM planning efforts in D10?
- What are your initial considerations?
- How would you go about developing a plan for corridor management?
- Who would you involve?
- What technologies/systems/actions would you consider?
- What are the major gaps or challenges you see in implementing the plan?
- What would you do to give your plan the best chance of success, especially considering the gaps/challenges?

Breakout Group Activity

- If ICM is implemented, how do you see agency roles and responsibilities changing?
  - Freeway
  - Arterial
  - MPO/Planning
  - Other partners
- Are there other strategies that the region should explore for ICM on the Altamont Corridor?
- Based on what you have heard over the last 2 days, what institutional and technical challenges do you see for ICM on the Altamont (or other) corridors?